

THE GASTEROMYCETES OF AUSTRALASIA. XI.

THE PHALLALES, PART II.

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(Plates viii-x.)

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This paper is a continuation of Part I of the Phallales (in which the family Phallaceae was discussed) and covers the Australian and New Zealand species included in the families Clathraceae and Claustulaceae.

Family II. CLATHRACEAE.

Peridium obovate or subglobose, at first submerged, becoming superficial or almost so; rupturing from the apex downwards to form several lobes, exposing the receptacle and persisting as a volva supporting this structure; gelatinous layer broken into plates by bands of intermediate tissue corresponding with the arms of the receptacle. Receptacle completely free within the volva, of various types, stipitate or sessile, clathrate, columnar, or of apically united, connivent or free arms arising from the apex of the stipitate base, chambered, pseudoparenchymatous. Gleba borne on the arms of the receptacle or upon some modified portion of these. Basidia bearing 4-8 sessile, elliptical, smooth, continuous spores.

The family may be separated into 3 distinct tribes, and contains the following 11 genera:

Key to the Tribes and Genera.

- Tribe I. STELLATEAE: Receptacle stipitate, of simple arms borne on the apex of a simple hollow stem; arms either apically organically united, connected by a membrane, free and connivent, or laterally expanded from the discoid apex of the stem.
- Arms apically organically united or united by a membrane.
- Glebiferous layer composed of irregular pseudoparenchymatous processes 1. (**Mycopharus*†)
- Glebiferous layer consisting of walls of the chambers of the arms 2. *Anthurus*.
- Arms apically free, connivent or expanded.
- Arms connivent (usually), attached to the apex of a simple cylindrical stem 3. *Lysurus*.
- Arms attached laterally to a horizontal discoid expansion of the apex of the cylindrical stem 4. *Aseroe*.
- Tribe II. COLUMNATEAE: Receptacle without a stipitate base, of simple columnar arms organically united apically, but free basally.

* Genera not occurring in Australia or New Zealand are placed in brackets.

† *Mycopharus* Petch (1926, p. 281) was proposed by Petch to replace *Pharus* (Petch, 1919, p. 59) which was erected to contain "*Lysurus Gardneri*"; *Pharus* being pre-occupied by a genus of the Gramineae.

Gleba attached to the inner surfaces of the columns.

Columns transversely rugose or smooth 5. *Lindera*.

Columns with lateral winged expansions 6. (*Blumenavia*).

Gleba attached to a pendent pulvinate structure attached to the ventral surface of the apex of the united columns 7. (*Laternea*).

Tribe III. CLATHRATEAE: Receptacle of arms anastomosing to form a globoid, hollow, sessile clathrate sphere, of arms clathrately arranged above, but columnar below and/or basally united to form a short cylindrical stem, or clathrate and supported upon a definite stem.

Receptacle with a definite cylindrical stem.

Receptacle arms not lobed 8. (*Simblum*).

Receptacle arms with numerous lateral capitate or clavate lobes attached exteriorly 9. (*Kalchbrennera*).

Receptacle clathrate above, arms below columnar and united basally to form a short cylindrical base 10. *Colus*.

Receptacle sessile or practically so, clathrate 11. *Clathrus*.

I have rearranged this family, dividing it into three tribes on account of the arrangement of the arms of the receptacle.

In the tribe Stellateae are placed the four genera *Mycopharus*, *Anthurus*, *Lysurus* and *Aseroe*, since all show a close resemblance one to another, consisting essentially of a receptacle, the base of which is a definite stipe, the apex divided into arms. In *Anthurus* (as emended below) the arms are organically united apically, in *Mycopharus* held together apically by a fine membrane, in *Lysurus* free apically but usually connivent (in occasional plants two or three of the arms may be united organically, cf. *L. sulcatus* and *L. mokusin*), and in *Aseroe* are laterally expanded and attached to the horizontal discoid apex of the stem of the receptacle. The arms of *Mycopharus* differ in the structure of the glebiferous layer from the other three genera included in the tribe, consisting of a series of thin processes or contorted plates closely compacted together.

In the tribe Columnateae I have placed the genera *Lindera*, *Blumenavia* and *Laternea*. All three possess a receptacle of simple columnar arms, apically united organically, but basally free. In *Lindera* the columns are smooth or transversely rugulose and bear the gleba on their inner surfaces; in *Blumenavia* the columns have strongly developed winged expansions, but otherwise the genus is similar to *Lindera*; and in *Laternea* the gleba is restricted to a pendent, pulvinate structure attached to the apices of the united columns.

In the tribe Clathrateae are placed the genera *Colus*, *Simblum*, *Kalchbrennera* and *Clathrus*. In all, the receptacle is composed of arms anastomosing to form a clathrate receptacle. In *Clathrus* the receptacle is clathrate throughout, and sessile, though in certain forms the lower arms tend to assume a columnar position, and occasionally are basally united to form a short tubular stem (upon this feature has been erected the genus *Clathrella*), approaching closely the genus *Colus*. This latter typically consists of a receptacle apically clathrate (that is, the arms in the upper portion anastomose to form a latticed structure), but below the arms assume a columnar position and fuse basally into a tubular flaring stem. *Simblum* has the appearance of a clathrate globoid receptacle carried at the apex of a cylindrical, hollow stem; and *Kalchbrennera* is of a similar structure, but in addition there arise exteriorly from the arms of the receptacle numerous clavate or capitate lobes. In all genera placed in the Clathrateae the arms form a closed receptacle, being united apically and basally, and this distinction is sufficient, in my opinion, to show that they are not closely related to the Columnateae.

The geographic distribution of genera of the family is interesting. *Mycopharus* is confined to Ceylon; *Blumenavia* to Brazil; *Laternea* to the West Indies;

Kalchbrennera to Africa; *Colus* is found in the Mediterranean region and Australia (possibly, too, in New Caledonia); *Simblum* in the West Indies and warmer regions of North and South America; *Linderia* in the south of North America, Hawaii, Ceylon, Japan and New Zealand; *Anthurus* in Australia, New Zealand, North and South America, Java and Ceylon; *Lysurus* in Europe, Asia, North America, Africa and Australia; *Aseroe* in Australia, New Zealand, Asia, Ceylon, India, South America and East Indies; and *Clathrus* has a world-wide distribution.

Development.

The development of *Clathrus ruber* has been worked out by Fischer (1890, p. 3). As in the Phallaceae the primordium arises from the rhizomorph as a small clavate body composed of an outer cortical and an inner medullary layer (Pl. viii, fig. 1). The medullary tissue enlarges rapidly and assumes a broadly pyriform appearance. It then becomes lobed (Pl. viii, fig. 2) and the lobes continue to enlarge unequally, being more numerous apically (where the arms in the mature receptacle are more numerous) and expand peripherally to form (ultimately) the gelatinous plates of the middle layer of the volva. Between the lobes lies undifferentiated tissue of the cortex, and as the lobes increase in size peripherally, this undifferentiated tissue becomes compressed between them to form the so-called intermediate tissue (Zwischenflecht) of Fischer (Pl. viii, figs. 1, 2, c). Where the lobes tend to flatten near the periphery, compression of the intermediate tissue leads to the formation of the thin peridial plates (Pl. viii, fig. 3, e); but towards the central part of the plant the undifferentiated cortical tissue occupies small cleft-like cavities, and in these spaces arise thickened hyphal knots, which are the fundaments of the arms of the receptacle (Pl. viii, fig. 3, d). These shortly become enclosed within a palisade of hyphae. The wall of the medullary tissue enclosing these clefts likewise becomes lined with palisade tissue, and between them a cavity appears, indicating the beginning of glebal formation, this being the first glebal chamber (Pl. viii, fig. 3, f). By radial elongation of the lobes of medullary tissue (which begin to gelatinize peripherally about this time) these cavities increase in size; the walls then become covered with hymenium, develop lateral expansions, which increase in size and number, and ultimately form the labyrinth of cavities and tramal plates of the gleba (Pl. viii, fig. 5, g). Development continues progressively towards the centre of the plant, until the whole of the medullary tissue lying within the zone indicated by the appearance of the first glebal cavities is converted into gleba.

Where the intermediate tissues come in contact with the gleba, the hyphae grow into certain of the glebal chambers and fill them with a luxuriant growth of hyphae. This, together with the palisade surrounding the hyphal knots, is then converted into pseudoparenchyma, giving rise to the walls of the arms of the receptacle. Those portions of intermediate tissue enclosed within the pseudoparenchyma gelatinize and in this manner are formed the chambers of the arms of the receptacle.

The labyrinth of glebal tissue then produces basidia and spores, and ultimately becomes gelatinized. Gelatinization of the peripheral portions of the lobes of the medullary tissue continues until the whole of the peripheral region is converted. In this manner is formed the middle layer of the peridium, which is broken into numerous areas by the peridial plates, which correspond in number and position to the arms of the receptacle (Pl. ix, fig. 18). The exterior layer of

the peridium is derived from the but slightly differentiated cortex (Pl. viii, fig. 5, *i*), and the inner layer is bounded by the peripheral zone of the gleba and arms of the receptacle.

As the receptacle develops its walls become thrown into folds (Pl. ix, fig. 18); and at maturity, increased turgour of the arms (and possibly, too, of the now gelatinized gleba) causes rupture of the peridium (along the sutures formed by the peridial plates), the receptacle expands considerably and becomes free, the peridium remaining then as a volva at its base (Pl. x, fig. 19).

In *Linderia columnata*, according to Burt (1896), development proceeds in a similar manner, save that only a few lobes of the medullary tissue are developed, due to the simplified nature of the receptacle. In this species development of the columns of the receptacle is continuous over the apical part (leading to the arms being organically united in the mature plant) but is interrupted basally, so that at maturity the columns are free from one another.

The development of these two species differs considerably from that described for members of the Phallaceae. For in *Mutinus* and *Ithyphallus* it was shown that the cortex gave rise to the outer layer of the peridium alone, all other tissues arising from the medulla. In *Clathrus* (and *Linderia*) the cortical tissue not only produces the outer layer of the peridium, but in addition the walls of the receptacle and peridial plates of the volva. A second feature of the Clathraceae is that so far as their development has been studied critically, the gleba develops interiorly to the tissues of the receptacle, whereas in the Phallaceae it develops externally to the pileus (or modified apex of the receptacle in *Mutinus*). These differences are sufficient to maintain these two families as distinct, and tend to show, moreover (since no intermediate forms are known) that they have had a different, though probably parallel, line of evolution.

1. ANTHURUS Kalchbrenner.

Grev., ix, 1880, p. 2. *Emend.*—*Pseudocolus* Lloyd, *Myc. Notes*, 1907, p. 356.

Peridium of 3 layers, the outer furfuraceous and thin, the middle one thick and gelatinous. Receptacle a short, cylindrical or flaring, hollow stem, bearing apically a variable number (3-8) of simple, brittle arms organically united apically (though often breaking free at maturity). Gleba borne on the inner surfaces of the arms, mucilaginous, fetid, olivaceous. Spores tinted or hyaline, continuous, smooth, elliptical.

Habitat.—Growing on the ground or on decaying wood.

Type species, Anthurus Archeri (Berk.) Fisch.

Distribution.—France; North and South America; Island of Reunion; Java; Ceylon; Japan; Australia; New Zealand.

This genus is characterized by the receptacle, which consists of a hollow, cylindrical or flaring stem bearing apically several simple arms united at their apices. In one species (*A. Rothae*) the stem is often considerably reduced, sometimes not projecting beyond the volva.

The genus was erected by Kalchbrenner upon a plant from Richmond River, New South Wales. The specimen no longer exists, consequently most subsequent workers have had to attempt identification of the species (and genus) from Kalchbrenner's description and crude illustration (Pl. 3, fig. 3). The latter does not resemble any known Phalloid (see Pl. viii, fig. 7), and would appear to be a composite sketch of *Aseroe rubra* and a plant Fischer (1890, p. 67) labelled *Anthurus Muellerianus* f. *aseroeformis*, collected by Bauerlen at Quedong, Gipps-

land. Fischer's illustration is based on a plant which McAlpine later named *A. aseroeformis*.

In 1860 Berkeley described *Lysurus Archeri* from a plant collected in South Tasmania. His description and illustration (see Pl. viii, fig. 8) show a plant resembling *A. Muellerianus* f. *aseroeformis*, but differing in that the apices of the five arms are united. Recent collections made in Australia and New Zealand have shown that Berkeley's plant is not uncommon, and that when the receptacle emerges from the peridium the arms are (usually) united apically (as his figure has shown them), but after exposure for a short time they tend to become detached (being decidedly brittle when fresh), the plant then assuming the form of Fischer's *A. Muellerianus* f. *aseroeformis*. It is obvious, therefore, that both are conditions of the same species, and that as Berkeley's name has priority, the specific name becomes *A. Archeri*.

Reference to Kalchbrenner's figure (Pl. viii, fig. 7) shows his *A. Muellerianus* to be a plant with eight free arms, attached to a short hollow stem; and as Berkeley's figure shows a plant with five united arms (Pl. viii, fig. 8), it may be thought that two different species are involved. But as in New Zealand forms with seven arms are not uncommon, it is evident *Lysurus Archeri*, *Anthurus Muellerianus*, and *A. Muellerianus* f. *aseroeformis* (= *A. aseroeformis* McAlp.) are but names for the same species.

Kalchbrenner's description of his genus *Anthurus* covers plants with "Receptacle stipitate, or with a very short stem, divided above into erect patent laciniae, free at the apices, but running down direct into the stem, and not distinct from it". And subsequent workers have had difficulty in determining the differences, if any, separating it from *Lysurus*. But as I have shown, the type species is a plant with the arms organically united apically, and that Kalchbrenner's figure refers to a weathered plant in which the arms had broken free. It is clear therefore that the concept of the genus has become changed, and that several species placed under it must be referred to *Lysurus*.

In 1907 Lloyd erected *Pseudocolus* to contain plants with arms organically united apically, and attached basally to a hollow stem; in other words to contain species placed under *Anthurus* as now defined. Thus *Pseudocolus* is but a synonym of *Anthurus*.

In the genus as emended, there are four species. Of these *Anthurus Garciae* (A. Moell.) n. comb. (= *Colus Garciae* A. Moell., *Braz. Pilz.*, 1895, p. 35) occurs only in Brazil, and differs from the others in its white receptacle; *A. javanicus* (Penz.) n. comb. (= *Colus javanicus* Penz., *Ann. Jard. bot. Buit.*, xvi, 1899, p. 160) is a red species with three arms, found in Java, Island of Reunion (as *Colus fusiformis* Fisch., 1890, p. 64), Japan (Lloyd, *Myc. Notes*, 1916, p. 586) and North America (as *Colus Schellenbergiae* Sumst., *Mycologia*, viii, 1916, p. 183); *A. Archeri* (Berk.) Fisch. is a red species with five to eight arms, and occurs in New Zealand, Australia, Tasmania, Mauritius, Malay Archipelago and France; and *A. Rothae* (Fisch.) n. comb. is confined to Australia.

1. ANTHURUS ARCHERI (Berkeley) Fischer. Pl. viii, fig. 6.

Jahrb. bot. Gart. u. Mus. Berlin, iv, 1886, p. 81.—*Lysurus Archeri* Berk., *Fl. Tas.*, ii, 1860, p. 264.—*L. pentactinus* Berk., *l.c.*, tab. 184.—*Anthurus Muellerianus* Kalch., *Grev.*, ix, 1880, p. 2.—*A. Muellerianus* f. *aseroeformis* Fisch., *Denskr. Schweiz. nat. Gesell.*, xxxii, 1890, p. 68.—*A. aseroeformis* (Fisch.) McAlp., in Lloyd's *Myc. Notes*, 1908, p. 408.—*Pseudocolus Archeri* (Berk.) Lloyd, *Letter 47*,

1913, p. 14.—? *Anthurus MacOwani* Marl., ex Lloyd, *Myc. Notes*, 1916, p. 570.—*Pseudocolus mauritanus* Lloyd, *Myc. Notes*, 1917, p. 689.—*Anthurus surinamensis* Fisch., *Ann. Myc.*, xxv, 1927, p. 471.

Peridium obovate, to 4 cm. diameter, but usually smaller, exterior furfuraceous, dingy-white. Receptacle with a short, hollow, usually flaring stem, to 5 cm. long, but often much less, 1-2.5 cm. diameter, attenuate and white below, slightly expanded, open and red above; divided directly into 5-8 simple arms, which are red, transversely rugulose on the interior, sutured longitudinally externally, chambered, apically united (usually) when freshly expanded, but commonly breaking away in older plants, varying from 3 to 7 cm. in length, occasionally bifurcate at the extremities. Gleba borne on the inner surfaces of the arms, fetid, olivaceous. Spores hyaline, elliptical, 6-7.5 × 2-2.6 μ .

Type locality.—South Tasmania.

Distribution.—Australia; Tasmania; New Zealand; Mauritius; Malay Archipelago; ? South Africa; ? France.

Tasmania: Type locality (Berkeley, *l.c.*).—N.S.W.: Richmond River (Kalchbrenner, *l.c.*); Mt. Royal Range; Yarrowitch; Squidgy Creek, near Bulli Pass (Cleland and Cheel, 1915, p. 207).—Vic.: Quedong, Gippsland (Fischer, *l.c.*); Upper Owens River (Fischer, *l.c.*); Melbourne (McAlpine, *l.c.*).—N.Z.: Unknown locality (Lloyd, *Letter 59*, 1915, p. 1); Peel Forest, Canterbury (Lloyd, *Letter 47*, 1913, p. 14); Cromwell, Otago, G.H.C.; Nelson, Dun Mt., G.H.C.

This is a red species somewhat uncommon in Australia and New Zealand. The arms vary in number from five to eight, plants with five arms being most frequently collected; they may be organically united, held together by a fine membrane (Cleland and Cheel, 1915, p. 207), or occasionally free, though the last two conditions are rare in freshly expanded plants; and may be entire at their apices (when broken away) or occasionally bifid. This last condition is rare and has been recorded but twice (by Berkeley, *l.c.*, and Cleland and Cheel, 1915, p. 206), and would appear to be limited to those arms which are organically free in unexpanded plants.

The variable nature of the species has led to considerable speculation as to its identity, with the result that it is found in literature under many names. As has been shown, it was first named in 1860 by Berkeley as *Lysurus Archeri* (and his illustration as *L. pentactinus*); in 1880 by Kalchbrenner as *Anthurus Muellermanus*; and by McAlpine in 1908 as *A. aseroeformis*. Then Lloyd (*Letter 47*, 1913, p. 14) recorded receipt of a specimen in which two of the six arms were united apically and concluded they were all so joined originally. The following year (*Letter 51*, 1914, p. 4) he received a coloured drawing from C. C. Brittlebank (Melbourne) showing a plant with all arms organically united apically, and accordingly renamed the species *Pseudocolus Archeri*. Then in 1917 Lloyd received from Mauritius a plant which he named *Pseudocolus mauritanus*. This had the five apically united arms and short stem of our plant and is accordingly considered to be the same species. In 1925 Lloyd (*Myc. Notes*, p. 1361) recorded the species (under the name of *Anthurus aseroeformis*) from France, and, judging from his illustration, his record would appear to be based on an authentic specimen. Finally Fischer recorded the species (as *A. surinamensis*) from Surinam, Malay Archipelago. His plant had the same five arms, red colour, short stem and organically connected arms (though some are broken apart in his illustration) and so must be regarded as the same species. I have examined three collections from Otago and Nelson and find that the number of arms varies, as

has been shown; for of the seven specimens examined, three possessed five arms, one had six, and three had seven.

2. ANTHURUS ROTHAE (Berk. ex Fischer), n. comb. (Pl. viii, fig. 9.)

Colus Rothae Fisch., *Denskr. Schweiz. nat. Gesell.*, xxxiii, 1893, p. 23, *nom. nudum*.—*Pseudocolus Rothae* (Fisch.) Lloyd, *Phall. Aus.*, 1907, p. 19.

Peridium white or greyish, subglobose, 1.5–2 cm. diameter, externally furfuraceous. Receptacle variable in size, 3–5 mm. tall, of 3 or 4 triquetrous or quadrate arms organically united apically, basally contracted to form a short, cylindrical, hollow stem; arms cream-coloured basally, orange or orange-red above, transversely rugulose, hollow, attenuate above and slightly arched outwards. Gleba olivaceous, borne on the inner surfaces of the upper parts of the arms, mucilaginous, fetid. Spores tinted, elliptical, smooth, $3\text{--}4 \times 1.5\text{--}2 \mu$.

Type locality.—Brisbane, Queensland.

Distribution.—Australia.

Queensland: Brisbane (Herb. Kew, Fischer, *l.c.*).—N.S.W.: Moonan Brook (Herb. Kew, Fischer, *l.c.*); Bulli Pass, 4/14, J. B. Cleland.*

This species is characterized by the three or four angular arms of the receptacle. The number of the arms varies, for out of eight specimens collected by Dr. Cleland, two had four arms, and the others had three, but in one of the latter, one arm was thicker and divided into two in its upper part. Another feature is that the stem of the receptacle is often reduced, when the plant is liable to be mistaken for a specimen of *Lindera*; but the organically united bases of the arms would show that such plants were of this species.

At Kew, according to Fischer (*l.c.*), the original collections forwarded by Bailey were labelled *Clathrus triscapus* and *Anthurus Rothae*; and a second collection from Moonan Brook labelled *Laternea triscapa*; which explains Cooke's reference (1892, p. 214) to the occurrence of *Laternea triscapa* in Australia.

2. LYSURUS Fries.

Syst. Myc., ii, 1822, p. 285.—*Aserocephallus* Lepr. et Mont., *Ann. Sci. Nat.*, ser. 3, iv, 1845, p. 360.

Peridium of 3 layers, the outer thin and furfuraceous, the middle layer thick and gelatinous. Receptacle a hollow cylindrical stem bearing apically several arms, distinct from the stem, and free apically. Gleba olivaceous, mucilaginous, fetid, borne on the surfaces of the arms. Spores elliptical, smooth, continuous.

Habitat.—Growing upon the ground.

Type species, *Lysurus mokusin* (L.) Fr.

Distribution.—Europe; Asia; North and South America; Africa; Australia.

The genus is characterized by the receptacle, which consists of a well developed cylindrical stem bearing apically a variable number of short arms which are apically free. It has regularly been confused with *Anthurus* (which is not surprising, since as that genus was originally defined there was no real difference between the two), and numerous efforts have been made to separate these two genera; as by Patouillard (1890), who attempted to define them upon the manner in which the gleba was borne on the arms. As *Lysurus mokusin* carries the gleba upon the exterior of the arms, Patouillard assumed that *Anthurus*

* Specimens marked thus are in the herbarium of Dr. J. B. Cleland, The University, Adelaide.

had the gleba borne internally on the inner surfaces of the arms, and made this the character of the two genera. Lloyd in his various papers attempted to show that *Lysurus* possessed a cylindrical, and *Anthurus* a flaring stem, and considered this to be the distinguishing feature.

Of the fifteen species which have been described, but four are valid, the others being synonyms either of these or of species of *Anthurus*. *Lysurus mokusin* (L.) Fr. has been recorded from China, Japan, Australia and California; *L. sulcatus* (Cke. et Mass.) n. comb. is known from Europe, North America and Australia; *L. cruciatus* (Lepr. et Mont.) Lloyd is based on a collection from French Guiana; and *L. Woodii* (MacOwan) Lloyd is confined to Africa.

1. *LYSURUS MOKUSIN* (L.) Fries.

Syst. Myc., ii, 1822, p. 286.—*Mutinus pentagonus* Bailey, *Queensland Bot. Bull.*, x, 1895, p. 35.—*Lysurus Beauvaisii* Moll., *Rev. Gen. Bot.*, xii, 1900, p. 61.—*Mutinus pentagonus* var. *Hardyi* Bailey, *Queensland Agr. Journ.*, xvi, 1906, p. 494.—*M. Hardyi* Bailey, *Comp. Cat. Queensland Pl.*, 1910, p. 747.—*Lysurus sinensis* Lloyd, *Myc. Notes*, 1917, p. 718.

Peridium subglobose, to 3 cm. diameter, white. Receptacle to 8×1.5 cm., stem white, fluted and 4-6 angled, hollow, coarsely chambered, acuminate below, bearing apically 4-6 arms, which are usually strongly connivent, to 25 mm. long, acuminate, rugulose, orange. Gleba olivaceous, fetid, borne on the exterior of the arms. Spores tinted, elliptical, $4-5.5 \times 1.8-2.2 \mu$.

Type locality.—Province of Mokusin, China.

Distribution.—China; Japan; California; Australia.

Queensland: Brisbane (F. M. Bailey, Hardy, J. H. Simmonds, Bailey, *l.c.*).

The species is characterized by the strongly fluted and angled stem of the receptacle, strongly connivent arms, and by the gleba being carried on the outside of the arms.

The Australian record is based on specimens collected in Queensland by Bailey and others. These were placed under *Mutinus* and described as new, two species and one variety being erected by Bailey according to whether the stem was four, five or six angled. Bailey's illustrations show all to be forms of *L. mokusin*. Lloyd's *L. sinensis* was based on a specimen from Japan, in which two of the arms were organically united at their apices. But as this feature is not uncommon in *L. sulcatus* and *L. Woodii* it has no specific import. Lloyd (*Myc. Notes*, 1916, p. 586) recorded the occurrence of the species in a glasshouse in California, where it doubtless has been introduced accidentally with plants or soil brought from the Orient. It is possible that it has been introduced similarly from China to the north of Australia.

2. *LYSURUS SULCATUS* (Cooke and Masee), n. comb.

Lysurus texensis Ellis, *Bull. Torrey Bot. Club*, vii, 1880, p. 30, *nomen nudum*.—*Mutinus sulcatus* Cke. et Mass., *Grev.*, xvii, 1889, p. 69.—*Lysurus australiensis* Cke. et Mass., *Grev.*, xviii, 1889, p. 6.—*Anthurus australiensis* (Cke. et Mass.) Fisch., *Denskr. Schweiz. nat. Gesell.*, xxxiii, 1893, p. 27.—*A. borealis* Burt, *Mem. Bost. Soc. Nat. Hist.*, iii, 1894, p. 504.—*Lysurus borealis* (Burt) P. Henn., *Hedw.*, xli, 1902, p. 167; var. *Klitzingii* P. Henn., *l.c.*, p. 173.—*L. tenuis* Bailey, *Comp. Cat. Queensland Pl.*, 1910, p. 745.

Peridium subglobose, white, to 3 cm. diameter. Receptacle to 15×2 cm., stem white below, cream-buff above, cylindrical, or acuminate below, hollow, of 1-3

layers of chambers, divided apically into 5-7 arms which are erect, hollow, narrowly lanceolate, 10-30 mm. long, apically attenuate, transversely rugulose, pallid-orange and differing in context from the stem. Gleba borne on the inner surface and edges of the arms, sometimes completely surrounding them, brownish, mucilaginous, fetid. Spores elliptical, smooth, hyaline or tinted, $4.5-5 \times 1.5-2 \mu$.

Type locality.—Brisbane, Queensland.

Distribution.—Germany; England; North America; Australia.

Queensland: Brisbane (Cooke and Masee, *l.c.*, Bailey, *l.c.*).—N.S.W.: Killara; Penshurst; Wahroonga; Botanic Gardens, Sydney; Woolwich; Milson Island; Cronulla Beach; Campsie; Richmond; Neutral Bay (Nat. Herb., Sydney, Cleland and Cheel, 1915, p. 206); Palm Beach, Sydney, 4/18*; Byron Bay, 4/16*, J. B. Cleland.—S. Aust.: Grange, 2/24, J. B. Cleland*; same loc., 4/24, Mrs. Kelly*; same loc., 4/25, A. J. Garfield Williams*; Millswood, 6/28, J. B. Cleland*.

This appears to be one of the most abundant Phalloids in Australia, judging from the number of collections recorded. It is identical in all particulars with *L. borealis*, as I have satisfied myself after examination of numerous collections from America and Australia. This has been previously pointed out by Lloyd (1909, p. 38). It differs from *L. Woodii* only in the orange colour of the arms, those of the latter being white, according to van der Bijl (1921, p. 192). Petch has shown (1919) that *Mycopharus Gardneri* differs in the structure of the arms of the receptacle. I have examined the microscopic structure of the arms of *L. sulcatus* and find they are composed of strongly convoluted folds of pseudo-parenchyma arranged in parallel series, forming a close palisade similar to that described (in part) by Petch.

Cleland and Cheel (1915, p. 204) have shown that the number of the arms varies from five to seven; and that forms with two or more of the arms organically united apically, laterally or by a delicate membrane are not uncommon. These forms show the close relationship of the genus to *Anthurus*. The disposition of the gleba is by no means constant; for it may be spread over the whole of the arms, and is quite common on the lateral surfaces of these structures. This shows the fallacy of delimiting genera upon the disposition of the gleba alone, as has been attempted by Patouillard, Fischer and others.

3. ASEROE La Billardière.

Ex Fries, *Syst. Myc.*, ii, 1822, p. 285.—*Calathiscus* Mont., *Ann. Sci. Nat.*, ser. 2, xvi, 1841, p. 278.

Peridium of 3 layers, the outer thin and furfuraceous, the middle one thick and gelatinous. Receptacle a hollow cylindrical stem bearing apically a horizontal discoid expansion, to the margin of which are attached a variable number of horizontally arranged arms, which may be simple or bifurcate. The apex of the stem is often covered with a diaphragm, usually with a small central perforation. Gleba mucilaginous, olivaceous, fetid, imposed upon the upper surface of the disc and proximal portions of the upper surfaces of the arms. Spores smooth, continuous, elliptical.

Habitat.—Growing solitary upon the ground or on rotting wood.

Type species, *Aseroe rubra* Lab. ex Fr.

Distribution.—China; Japan; Ceylon; South America; East Indies; Australia; New Zealand.

The genus is characterized by the manner in which the numerous, usually awl-like arms are laterally inserted into the discoid expansion of the apex of the

stem, and presence of a diaphragm (an inward continuation of the disc) covering its apical aperture. Its relationship to *Anthurus* is indicated by occasional plants of *Anthurus Archeri* which possess apically free, shortly bifurcate and awl-like arms.

There are but three valid species in the genus, the many others described being synonyms of these. *A. arachnoidea* Fisch. is known from Cochin China and Java, and differs from the others in its white colour and the fact that the arms are inserted singly into a barely perceptible disc; *A. ceylanica* Berk. occurs in Ceylon and Tonkin and is a red species differing from *A. rubra* in the much broadened apical disc of the receptacle; and *A. rubra* Lab. ex Fr. is restricted to Australia, Tasmania, New Zealand and New Caledonia.

1. *ASEROE RUBRA* La Billardière. Plate viii, fig. 10; Pl. ix, figs. 11, 12.

Ex Fries, *Syst. Myc.*, ii, 1822, p. 285.—*A. pentactina* Endl., *Icon. Gen. Pl.*, Pl. 1, 1838.—*A. viridis* Berk. et Hook., in Hook. *Journ. Bot.*, iii, 1844, p. 192.—*Lysurus aseroeiformis* Cda., *Icon. Fung.*, vi, 1854, p. 22.—*Aseroe actinobola* Cda., *l.c.*, p. 23.—*A. Hookeri* Berk. *Fl. N.Z.*, ii, 1855, p. 187.—*A. corrugata* Col., *Trans. N.Z. Inst.*, xvi, 1883, p. 362.—*A. lysuroides* Fisch., *Jahrb. bot. Gart. u. Mus. Berlin*, iv, 1886, p. 89.—*A. rubra* a. *typica* Fisch.; b. *pentactina* (Endl.) Fisch.; c. *actinobola* (Cda.) Fisch.; d. *Muelleriana* Fisch.; in Sacc. *Syll. Fung.*, vii, 1888, p. 26.—*A. Hookeri* a. *miniata* Fisch.; b. *viridis* Fisch., *l.c.*—*A. Muelleriana* (Fisch.) Lloyd, *Syn. Phall.*, 1909, p. 46.—*A. pallida* Lloyd, *l.c.*, p. 47.—*A. poculiforma* Bailey, *Comp. Cat. Queensland Pl.*, 1910, p. 746.

Peridium obovate, to 3 cm. diameter, dingy-white. Receptacle stem cylindrical or flaring, hollow, chambered, to 6 × 2 cm., white and attenuate below, pink and expanding above into a broad, horizontal, orbicular disc, to 3.5 cm. diameter, to which the arms are attached laterally. Diaphragm usually well developed, smooth or definitely rugulose, sometimes almost wanting. Arms in 5–9 pairs, conniving, to 3.5 cm. long, 6 mm. wide near the base, longitudinally grooved basally, rugose on both surfaces, but more deeply on the upper, or almost smooth, bifurcate at about 15 mm. from the base (sometimes bifurcate only near the apices), subulate towards the tips, which are often twisted. Gleba covering disc, diaphragm and upper surfaces of the lower portions of the arms, fetid, mucilaginous, olivaceous. Spores tinted, often hyaline, elliptical, smooth, 4–5.5 × 1.5–2 μ .

Type locality.—South Tasmania.

Distribution.—Tasmania; Australia; New Zealand; New Caledonia.

Tasmania: No locality (Nat. Herb., Sydney, Cleland and Cheel, 1915, p. 209; La Billardière, ex Fries, *l.c.*).—Queensland: Brisbane (Bailey, *l.c.*, as *A. poculiforma*).—N.S.W.: Byng; Peakhurst; Turramurra; Camperdown; Penshurst; Killara; Woollahra; Croydon; Parramatta; Chatswood; Lismore; Rookwood; Weston; West Maitland; North Sydney; Neutral Bay (Nat. Herb., Sydney, Cleland and Cheel, 1915, p. 212).—Victoria: East Gippsland (herb. Berlin, Fischer, 1890); Dandenong (Berk., *Journ. Linn. Soc., Bot.*, xiii, 1872, p. 170).—New Zealand: Common throughout the lowland forests of both Islands.

This is an abundant species throughout New Zealand, for I have collected it in all Provinces; and it appears to be equally abundant in East Australia and Tasmania. It is decidedly variable as to size, colour, number of arms, diameter of the discoid expansion of the stem, and degree of roughening of the disc, diaphragm and arms. Thus it is not surprising to find the species has many synonyms. *A. pentactina* Endl. was erected on a species with five bifid arms;

A. viridis Berk. et Hook. was supposed to be a metallic-green (!) colour. Later Berkeley re-named it *A. Hookeri* Berk. on account of its supposed small size. I have examined the type at Kew and find it to be identical with one of our many forms. *Lysurus aseroeformis* Cda. and *A. lysuroides* Fisch. are names for a form from Tasmania in which the stem is longer and the base of the arms broader than in the original plant. Fragments of the "type" are, according to Fischer (1890, p. 73) in herb. Delessert in Geneva. *A. corrugata* Col. differs slightly from the typical form in the surfaces of the arms being more rugulose; but this is a condition so variable as to possess no significance. *A. Muellieriana* (Fisch.) Lloyd is a form in which the disc is much broader, more roughened interiorly, and the arms shorter than in the typical form, and on this account may possibly be worthy of a varietal name (Pl. ix, fig. 13). *A. pallida* Lloyd was based on a specimen from New Caledonia with a white stem and pale-rose disc. It appears to be identical with our plant. *A. poculiforma* Bailey was based on a specimen in which the arms were less expanded than usual, a not uncommon condition where plants are growing among grass or partially buried in dead leaves and other debris on the forest floor.

The colour of the plant varies somewhat, pink or bright-scarlet forms being the most common. I have collected on two occasions (Weraroa, May, 1919, and York Bay, Sept., 1927) plants with a perfectly white receptacle, the only colour present being that of the gleba. These specimens were identical in all other respects with the red form and were found on rotting wood. The number of the pairs of arms varies from five to nine. In typical plants they are bifurcate for about three-fourths of their length, but even this condition varies, for in some specimens the arms may be bifurcate only near their extremities, or from their junction with the disc. Several may fuse together, or become twice bifurcate at their apices.

4. LINDERIA, n. gen.

Peridium subglobose, of 3 layers, the outer furfuraceous, the middle one thick and gelatinous. Receptacle of simple columns, organically united apically, but free and tapering basally. Columns chambered, pseudoparenchymatous, smooth or transversely wrinkled, but not winged; bearing on their upper parts of the inner surfaces the mucilaginous, olivaceous gleba. Spores elliptical, smooth, continuous.

Habitat.—Growing upon the ground.

Type species, Clathrus columnatus Bosc.

Distribution.—North America; West Indies; Hawaii; Japan; New Zealand.

This genus has been erected to contain those species possessing a columnar receptacle and arms organically united apically, but free basally. That this is a characteristic feature is evident when it is remembered that all genera placed in the tribe Columnateae (*Linderia*, *Laternea* and *Blumenavia*) possess this same feature.

Earlier workers have had considerable difficulty in placing species belonging to this genus, for we find them scattered equally through *Clathrus*, *Colus* or *Laternea*. Fischer (1890, p. 55), for example, considered *Laternea triscapa*, *Linderia pusilla*, *Linderia columnata* and *Clathrus ruber* to be forms of the same species. As these are valid species, belonging to three different genera, it is evident Fischer had but a scant knowledge as to the generic limits of the Clathraceae. Most subsequent workers have followed Fischer, and placed several,

if not all, of the valid species of *Linderia* under *Clathrus* or *Colus*; save Lloyd (1909), who placed them under *Laternea*.

Linder (1928, p. 109) has shown that the genus *Laternea* was erected upon a species possessing simple columns which subtend from the junction of the apices an angular, subobovate structure to which the gleba is restricted. The presence of this specialized glebiferous structure leaves those species with the gleba carried upon the inner surfaces of the columns without a generic name, and for this reason I have erected *Linderia*, in honour of David H. Linder, Mycologist to the Missouri Botanic Gardens, who has so clearly defined the characters of the genus *Laternea*. Linder suggested that Rafinesque's proposed name *Colonnaria* be used. But as Rafinesque did not describe or illustrate his genus, nor indicate a type species (his contribution (1808) being "*Colonnaria* (*urceolata*, *truncata*, etc.) divided into four pillars, united at the top, which bear the seeds in the margin. Found in Penn."), it is evident that it is mere guesswork to assume he was dealing with any of the species under consideration, or in fact with a fungus at all.

As defined, the genus contains the following three species: *Linderia columnata* (Bosc), n. comb.; *Linderia bicolumnata* (Lloyd), n. comb. (= *Laternea bicolumnata* Lloyd, *Myc. Notes*, 1908, p. 405); and *Linderia pusilla* (Berk. et Curt.) n. comb. (= *Laternea pusilla* Berk. et Curt., *Journ. Linn. Soc. Bot.*, x, 1869, p. 343). The distribution of the first is given below; the second is confined to Japan; and the third to Cuba.

1. LINDERIA COLUMNATA (Bosc.), n. comb. Plate ix,² figs. 14, 15.

Clathrus columnatus Bosc., *Mag. Gesell. nat. Freunde Berlin*, v, 1811, p. 85.—*C. colonnarius* Leman, *Dict. Sci. Nat.*, ix, 1817, p. 360.—*Laternea columnata* Nees et Henry, *Syst. d. Pilze*, ii, 1858, p. 96.—*Clathrus cancellatus c. columnatus* Fisch., *Denskr. Schweiz. nat. Gesell.*, xxxii, 1890, p. 56.—*Clathrus trilobatus* Cobb, *Rept. Exp. Stn. Hawaii Sugar Pl. Assn. Bull.* 5, 1906, p. 209.

Peridium subglobose, to 3 cm. diameter, rupturing irregularly from the apex downwards. Receptacle of 3-5 (commonly 3-4) columnar arms, basally free and acuminate, apically united, arched slightly outwards, chambered, transversely rugulose or papillate interiorly, longitudinally striate exteriorly, shading from pallid-orange below to ruby-red at the apex. Gleba spread over the inner surfaces of the upper portions of the arms, olivaceous, mucilaginous, strongly fetid. Spores tinted, elliptical, smooth, 3.8-6 × 1.5-2.5 μ .

Type locality.—South Carolina.

Distribution.—North and South America; West Indies; Hawaii; New Zealand.

New Zealand: Lynton Downs, Canterbury (Herb. Kew, Lloyd, *Myc. Notes*, 1906, p. 298); Kaituna, Canterbury, Miss Watson, 5/21 (Herb. Canterbury Museum).

The presence of the species in New Zealand is based on the two records cited above. The Kaituna specimen forms the subject of our illustration, and differs from typical forms of the species in the more slender, more coarsely cellular arms; but in this highly variable plant this is scarcely of specific significance. Occasionally the arms where apically united, form a flattened dome, and in extreme forms there may be present distinct perforations giving the plant a somewhat clathrate appearance (*cf.* Fischer's illustration of *Clathrus cancellatus* e. *Fayodi*, 1890, Pl. 5, f. 37; Coker and Couch, 1928, Pl. 1), and for this reason it has been included under *Clathrus* by most workers; but the free bases of the arms of the receptacle show that it is not closely related (Pl. ix, fig. 15).

5. COLUS Cavalier and Sechier.

Ann. Sci. Nat., ser. 2, iii, 1835, p. 251.—*Clathrella* Fisch., *Nat. Pflanzenfam.*, i, 1900, p. 284, *pro parte*.

Peridium obovate, smooth externally, of 3 layers. Receptacle with arms anastomosing apically to support a clathrate dome, below forming several short columns which unite basally to form a hollow, flaring, tubular, stem-like base. Gleba borne on the inner surfaces of the upper portions of the arms, olivaceous, fetid, mucilaginous. Spores smooth, elliptical, continuous.

Habitat.—Growing on sandy soil or on dung.

Type species, *Colus hirudinosus* Cav. et Sech.

Distribution.—Southern Europe (France, Spain, Portugal); North Africa; Ceylon; Australia.

The genus is characterized by the receptacle which typically consists of a clathrate dome supported on arms arranged in columnar fashion and produced basally to form a short, cylindrical, stem-like base. Thus defined, it closely resembles certain species of *Clathrus*, especially those placed by Fischer in *Clathrella*. Notwithstanding the fact that the genus was based on a species possessing a receptacle of the type described, numerous workers have referred to it plants which belong to *Anthurus*, *Mycopharus*, or *Clathrus*. The following is the only species usually recognized (which really belongs to the genus), but as is shown under *Clathrus*, it is possible other species exist.

1. COLUS HIRUDINOSUS Cav. et Sech. Pl. ix, fig. 17.

Clathrus hirudinosus Tul., *Expl. Sci. Alg.*, 1849, p. 435.

Peridium obovate, to 2.5 cm. diameter, white or dingy-grey externally. Receptacle to 6 cm. tall, apically sparsely clathrate, centrally of 5–7 (or in rare cases more) slender columnar arms united basally into a short cylindrical stem. Arms angled, transversely rugulose, red above, orange below. Gleba olivaceous, borne on the inner surfaces of the arms of the upper portion of the receptacle, fetid. Spores tinted, elliptical, smooth, $5-6 \times 1.5-2.2 \mu$.

Type locality.—Toulon, France.

Distribution.—Southern Europe; North Africa; Australia.

N.S.W.: Milson Island, Hawkesbury River, 3/16, J. B. Cleland*; Byron Bay, 4/16, J. B. Cleland*.

The collections made by Dr. Cleland are exactly as the plant was figured by Tulasne (*l.c.*) as our figure (based on a water-colour in the possession of Dr. Cleland) shows; but differs from the photograph of specimens from Portugal published by Lloyd in being less clathrate and the stem-like base less developed. Cooke (1892, p. 215) recorded the species from Western Australia and illustrated it with a copy of Tulasne's figure (Pl. 23); but according to Fischer (1890, p. 63) this record was based on a plant he (Fischer) named *Colus Muelleri*, which is in my opinion merely a specimen of *Clathrus pusillus* with a rudimentary stem-like base.

5. CLATHRUS Micheli.

Ex Persoon, *Syn. Meth. Fung.*, 1801, p. 241.—*Clathrus*§*Clethria* Fr., *Syst. Myc.*, ii, 1822, p. 287.—*Ileodictyon* Tul., *Ann. Sci. Nat.*, ser. 3, ii, 1844, p. 114.—*Clathrella* Fisch., *Nat. Pflanzenfam.*, i, 1900, p. 284, *pro parte*.

Peridium globose or obovate, exterior thin and furfuraceous, middle layer thick and gelatinous. Receptacle of several arms organically united to form a

hollow latticed sphere; sometimes arms arranged in columnar fashion below, and in extreme forms prolonged into a short cylindrical stem-like base; arms smooth or rugulose, in section elliptical, angled or rounded, cellular or tubular. Gleba borne on the inner surfaces of the arms, mucilaginous, olivaceous, fetid. Spores elliptical, smooth.

Habitat.—On the ground or on decaying wood.

Type species, *Clathrus ruber* Mich. ex Pers.

Distribution.—World-wide.

The genus, as defined above, contains plants in which the arms are organically anastomosed to form a clathrate spherical receptacle. In several species there occur forms with the lower arms arranged in columnar fashion, and projected basally to form a short, hollow, stem-like base. These last closely approach *Colus*, and indeed have led Fischer and others to a misinterpretation of the latter genus. For they have referred to *Colus* plants placed by myself under *Anthurus*, or by Lloyd under *Pseudocolus*. And to make the position more confusing, Fischer erected *Clathrella* to contain these intermediate forms.

Anthurus contains species in which the simple arms are borne on a distinct stem, and apically organically united; *Colus* possesses a flaring stem bearing apically a few columnar arms which apically branch and anastomose to form a clathrate dome (*cf.* the type species); if these points are borne in mind, little confusion should arise, and it will become apparent moreover that *Clathrella* is untenable.

Many workers have also confused *Lindëria* (as *Colus* or *Laternea*) with *Clathrus* but this confusion cannot arise if it is remembered that in *Lindëria* the bases of the arms are free, whereas in *Clathrus* they are organically united.

Tulasne erected *Ileodictyon* to contain those species with tubular arms, as opposed to the cellular arms of such species as *Clathrus ruber*. But as the type of his genus (*C. cibarius*) contains plants which are either tubular or coarsely chambered (small specimens being tubular, large ones chambered) this distinction cannot be considered as of generic value.

There would appear to be ten valid species in the genus (*Clathrus delicatus* Berk. et Br. being in my opinion a *Colus*) which can be divided into sections according to the colour of the receptacle, cellular or tubular nature and degree of roughening of the arms. Of the red species *C. crispus* Turp. occurs in the West Indies, and North and South America; *C. crispatus* Thwaites is confined to Ceylon; *C. ruber* Mich. ex Pers. is common in Europe, southern North America, South America and North Africa; *C. pusillus* Berk. is confined to Australia; and *C. Treubii* (Bern.) Lloyd to Java. Of the white species *C. Preussii* (Fisch.) Lloyd is known from a single collection from East Africa; *C. chrysomycelinus* A. Moell. is confined to Brazil; *C. gracilis* (Berk.) Schlecht. is confined to Australia; and *C. cibarius* (Tul.) Fisch. to Australia and New Zealand. Lastly *C. camerunensis* P. Henn., recorded from Africa, is said to differ in possessing an olivaceous receptacle, which seems improbable.

1. *CLATHRUS CIBARIUS* (Tulasne) Fischer. Pl. ix, fig. 18; Pl. x, figs. 19, 20.

Jahrb. bot. Gart. u. Mus. Berlin, iv, 1886, p. 74.—*Ileodictyon cibarium* Tul., *Ann. Sci. Nat.*, ser. 3, ii, 1844, p. 114.—*Clathrus Tepperianus* Ludw., *Bot. Centralbl.*, xliii, 1890, p. 7.—*Ileodictyon giganteum* Col., *Trans. N.Z. Inst.*, xxv, 1892, p. 324.—*Clathrus Higginsii* Bailey, *Queensland Ag. Jour.*, xxix, 1912, p. 487.

Peridium obovate or subglobose, dingy-white, to 7 cm. diameter. Receptacle sessile, white, subglobose or commonly obovate, to 15×10 cm., composed of numerous obliquely anastomosing arms, which are transversely rugulose, in section elliptical, tubular or more often coarsely cellular, not or scarcely thickened at the interstices (though in some forms attaining a thickness twice that of the arms). Gleba covering the inner surfaces of the arms, olivaceous, mucilaginous, fetid. Spores tinted, elliptical, smooth, $4-6 \times 1.8-2.5 \mu$.

Type locality.—Waitakei, Otago, New Zealand.

Distribution.—New Zealand; Australia.

N.S.W.: Arncliffe; Gladesville; Yarrangobilly (Nat. Herb., Sydney, Cleland and Cheel, 1915, p. 216).—South Australia: Blackwood, 7/30, E. Ashby*.—New Zealand: Common throughout the lowland areas of both Islands.

This is the only *Clathrus* known to occur with certainty from New Zealand, where it is exceedingly common in certain seasons, being found in spring and autumn on the edges of forest clearings, or freshly-turned earth at roadsides or tracks cut through the forest. It occurs sparingly in Australia, but its distribution is not certainly known since the species has been confused by earlier workers with the following one. Fischer recorded it from Chile, West Africa (1890, p. 53) and East Africa (1893, p. 19). I believe, however, that the species is confined to this biologic region, and that Fischer has confused it with plants later named *C. Preussii*, *C. chrysomycelinus* or *C. camerunensis*.

The receptacle varies greatly in size (5-15 cm.) and in the number and arrangement of the arms. In many plants the arms are numerous, and form a close mesh, in which the polygonal interspaces are small; in others the arms may be few and the meshes large and angular. The arms may anastomose in such a regular manner that in plants detached from the volva it is not possible to determine the apex from the base; or in others the arms towards the base may be arranged in columnar fashion, or in rare cases produced to form a small basal tube-like stem. The surfaces of the arms may be smooth, finely transversely wrinkled, or exteriorly longitudinally grooved. In section they may be tubular or coarsely cellular, both conditions being not infrequent in the same plant.

The receptacle is not attached to the volva in any way, consequently it may be readily detached and carried by wind for some distance from its place of origin. The appearance of these latticed structures without visible means of attachment to the substratum was a potent source of mystification to the Maori. Forced to find some explanation of their (to him) mysterious appearance, and guided no doubt by their characteristic odour he came to the conclusion (according to Mr. Elsdon Best) that they were *tutae kehua* or *tutae whetu* ("Faeces of ghosts or of the stars"). The specific name (*cibarius* = edible) was applied to the species under the impression that the unexpanded plant was used as an article of food by the Maori. But this is improbable as it is scarcely likely he would meddle with a plant obviously (to him) of supernatural origin. This view is supported by Mr. Best, who has advised me that the plant was not included among those fungi considered edible by the Maori.

2. CLATHRUS GRACILIS (Berkeley) Schlechtendal.

Linnaea, xxxi, 1862, p. 166.—*Ileodictyon gracile* Berk., in Hook. *Lond. Journ. Bot.*, iv, 1845, p. 69.—*Clathrus albidus* Lothar ex Fisch., in Sacc. *Syll. Fung.*, vii, 1888, p. 20. *C. intermedius* Fisch., *Denskr. Schweiz. nat. Gesell.*, xxxiii, 1893, p. 20.

Receptacle white, sessile, variable in size and shape, 4–20 cm. diameter, arms smooth, often longitudinally sulcate externally, in section flattened, to 5 mm. thick, tubular, or with 2 or more tubes welded, expanded at the interstices. Gleba borne on the inner surfaces of the arms, olivaceous, fetid, mucilaginous. Spores hyaline or tinted, elliptical, smooth, $4.5-6 \times 1.8-2.5 \mu$.

Type locality.—Swan River, Western Australia.

Distribution.—Australia; Tasmania.

Western Australia: Swan River (Berkeley, *l.c.*). Perth, W. M. Carne, 7/26.—South Australia: Barossa Range (Fischer, 1893, p. 19); Greenhill Road, 7/22, J. B. Cleland*; Mt. Charles, Charleston, 7/30, J.B.C.*; Adelaide, 6/23, M. Bailey*; Salisbury*; Kinchina, 7/23, J.B.C.*; Encounter Bay, 5/28, J.B.C.*; Kalangadoo, 5/28, J.B.C.*; Monash, 7/22, H. G. Taylor*.—N.S.W.: Richmond River (Fischer, *l.c.*, as *C. intermedius*); Sydney Botanic Gardens; Centennial Park; Botany; Mosman; Manly; Artarmon; Roseville; Cheltenham; Concord; Rookwood; Parramatta; Milson Island; Jerilderie; Armidale; Gostwyck, Uralla; Geeron, Forbes; Clareval, Stroud; Ingleburn; Springbrook; Deepwater; Moss Vale (Nat. Herb., Sydney, Cleland and Cheel, 1915, p. 217); Sydney, 6/15, J. B. Cleland*; National Park, 7/16, J.B.C.*; Wahroonga, 7/16, W. B. Stokes*.—Victoria: Melbourne (Fischer, 1890, p. 53).—Tasmania: Penginte (Nat. Herb. Sydney, Cleland and Cheel, 1915, p. 217).

This is somewhat similar to *C. cibarius* as to size and colour, but is quite a distinct plant, though the differences are difficult to define; and for this reason it was considered as a synonym by Fischer (1890, p. 53). In typical plants the arms are much thinner, are smooth (invariably rugulose or wrinkled in *C. cibarius*), flattened and composed of one or two (rarely more) continuous tubes. Another feature is that glebal development is frequently so copious as to coat the whole surface of the arms with the sage-green spore mass. In dried plants the arms usually assume the appearance of very fine and narrow ribbons, often only 1 mm. or so in diameter, and are characteristic on this account. It is the most abundant species in Australia, but does not occur in New Zealand.

3. CLATHRUS PUSILLUS Berkeley. Plate x, fig. 21.

In Hook. *Lond. Journ. Bot.*, iv, 1845, p. 67.—*Colus Muelleri* Fisch., *Denskr. Schweiz. nat. Gesell.*, xxxii, 1890, p. 61.—*Clathrella pusilla* (Berk.) Fisch., *Nat. Pflanzenfam.*, i, 1900, p. 284.—*Simblum Muelleri* (Fisch.) Lloyd, *Syn. Phall.*, 1909, p. 64.

Peridium obovate, to 20 mm. diameter. Receptacle red, obovate, to 4 cm. diameter, clathrate, the arms somewhat columnar below, sometimes united into a stem-like base, or in certain forms clathrate above and below, columnar equatorially; arms transversely rugulose, exteriorly longitudinally sulcate, tubular. Gleba borne on the inner surfaces of the arms, fetid, olivaceous, mucilaginous. Spores hyaline, elliptical, smooth, $4.5-5.5 \times 1.5-2.2 \mu$.

Type locality.—Swan River, Western Australia.

Distribution.—Australia.

Western Australia: Swan River (Berkeley, *l.c.*); Gilgering (Cleland and Cheel, 1915, p. 215, in Nat. Herb. Sydney); Tammin, 10/26, W. M. Carne.—Queensland: Wide Bay (Berkeley, *Journ. Linn. Soc.*, xiii, 1873, p. 172); Burnett District (Herb. Brit. Mus., Fischer, 1893, p. 22).—N.S.W.: Swanbrook; Milson Island (Cleland and Cheel, 1915, p. 215); Byron Bay, 4/16, J. B. Cleland*.—

Victoria: Upper Murray River (Fischer, *l.c.*, as *Colus Muelleri*); Gippsland (Fischer, 1893, p. 22).

This small red species appears to be not uncommon, and fairly widely though scantily distributed. Fischer (1890, p. 54) recorded the species from New Caledonia, basing his record upon a specimen in the herbarium Mus. Nat. Paris, which Patouillard (*Bull. Soc. Myc. Fr.*, iii, 1887, p. 173) referred to *Colus hirudinosus*; so that its geographic range (if this record is authentic) includes New Caledonia.

The plant may be truly clathrate, or the basal arms may be arranged below in columnar fashion; and in one collection (Upper Murray River) these columnar arms are produced into a short tubular base. This extreme form has been named *Colus Muelleri* by Fischer, and *Simblum Muelleri* by Lloyd, which well illustrates the danger of erecting species upon single specimens.

Doubtful and Excluded Species.

a.—*Clathrus crispus* Turp.—This was recorded from Rockingham Bay, Queensland, by Berkeley (*Journ. Linn. Soc.*, xiii, 1873, p. 172), but from his description I should say that this was a misdetermination of *C. pusillus*; and this is supported by the fact that *C. crispus* has not been recorded subsequently or elsewhere from this region.

b.—*Clathrus ruber* Mich. ex Pers.—Fischer (1893, p. 25) stated that at Kew there is a specimen of this species from New Zealand collected by Colenso. This Lloyd (*Myc. Notes*, 1906, p. 296) claimed to be *C. cibarius*, which is probable, for there is no other record of a red species of the genus being present in the Dominion. It may be *Linderia columnata*, for it will be remembered that Fischer confused the two species.

Family III. CLAUSTULACEAE, n. fam.

Peridium of 2 layers, the inner layer thick, gelatinous and forming a continuous layer, peridial plates being absent. Receptacle a hollow, indehiscent sphere, wall chambered and pseudoparenchymatous. Gleba covering the interior of the receptacle wall, confined to a single layer of glebal chambers, mucilaginous matrix wanting. Spores continuous, smooth, elliptical.

This family has been erected to contain the solitary genus *Claustula*. The presence of the typical peridium (although only 2-layered) and chambered receptacle shows it to belong to the Phallales; but the indehiscent receptacle, absence of the mucilaginous matrix and fetid odour of the gleba show it differs sufficiently from the Phallaceae and Clathraceae to warrant the erection of an additional family.

1. CLAUSTULA Curtis.

Ann. Bot., xl, 1926, p. 476.

Peridium of 2 layers, the outer thin and furfuraceous, the inner thick, gelatinous and without peridial plates. Receptacle obovate or subglobose, indehiscent, hollow; wall chambered, pseudoparenchymatous, gleba forming a thin layer over the inner wall of the receptacle, non-mucilaginous and without the characteristic odour of other members of the order.

Habitat.—Growing upon the ground.

Type species, Claustula Fischeri Curtis.

Distribution.—New Zealand.

1. *CLAUSTULA FISCHERI* Curtis.

Peridium obovate, to 4.5 cm. diameter, furfuraceous, white, becoming reddish-brown, rupturing from the apex to form 4-5 acuminate lobes. Receptacle obovate or subglobose, to 5 cm. long, white, smooth, indehiscent, free within the volva; wall chambered. Gleba borne on the inner wall of the receptacle, inodorous, non-mucilaginous. Spores olivaceous, elliptical, smooth, 8-13 × 5-6 μ , shortly pedicellate.

Type locality.—Fringe Hill, Nelson, N.Z.

Distribution.—New Zealand.

Nelson: Fringe Hill, 500 m., 8/23, Miss K. M. Curtis; same loc. 7/27, G.H.C.; Dun Mt. Track, 2/28, G.H.C.

This interesting plant may be best likened to an egg (the receptacle) held in an egg cup (the volva). The volva is of the typical Phalloid type, with an outer furfuraceous and an inner thick and gelatinous layer; but differs in that the third layer is wanting, the gelatinous layer ending abruptly in a smooth surface. The receptacle is egg-shaped, hollow, of the usual chambered pseudoparenchyma, and apparently indehiscent. The gleba is produced within a single layer of lenticular cells, attached to the inner wall of the receptacle. It differs from that of the typical Phalloids in being practically non-mucilaginous and inodorous. The spores, too, are much larger than is usual in this order, and are provided with a short persistent pedicel. One additional interesting feature is that in the immature plant a thin strand of primordial tissue connects the base of the peridium with the inner tissue of the receptacle through a narrow pore at the base of the latter.

The absence of peridial plates in the gelatinous layer of the peridium shows that the affinities of this plant are more with the Phallaceae than the Clathraceae; but the development of the gleba interiorly to the tissue of the receptacle shows relationships with the Clathraceae.

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EXPLANATION OF PLATES VIII-X.

Plate viii.

Fig. 1.—Development of *Clathrus ruber*, $\times 12$.—Longitudinal section showing medullary tissue forming the central columella of the primordium (*a*); the cortical tissue (*b*); and "intermediate tissue" (*c*).

Fig. 2.—Same at a later stage, $\times 12$.—Longitudinal section showing commencement of development of lobes of medullary tissue. Commencement of hyphal knots is shown at (*d*).

Fig. 3.—Same, showing commencement of development of hyphal knots which later give rise to the pseudoparenchyma of the receptacle (*d*); peridial plates shown at (*e*); first glebal chamber at (*f*). $\times 12$.

Fig. 4.—Same, showing development of glebal chambers (*f*); and tramal plates (*g*). $\times 12$.

Fig. 5.—Cross section of the same species showing further development of tramal plates (*g*) which now form the labyrinth of the gleba; receptacle arms (*d*); peridial plates (*e*); mesoperidium now clearly defined (*h*); and exoperidium indicated at (*i*). $\times 12$.

(Figures 1-5 after Fischer, 1890.)

Fig. 6.—*Anthurus Archeri*. $\times \frac{3}{4}$.—Photograph of a water colour drawing by C. C. Brittlebank showing the five organically united arms of the receptacle and the short flaring stem.

Fig. 7.—*Anthurus Archeri*. $\times \frac{3}{4}$.—Reproduction of Kalchbrenner's drawing of *A. "Muellerianus"*. (After Kalchbrenner, 1880.)

Fig. 8.—*Anthurus Archeri*. $\times \frac{3}{4}$.—Reproduction of Berkeley's drawing of "*Lysurus Archeri*". (After Berkeley, 1860.)

Fig. 9.—*Anthurus Rothae*. $\times \frac{2}{3}$.—Photograph of a water-colour drawing by Miss Phyllis Clarke in the possession of Dr. Cleland. Plant collected at Katoomba, 12/16.

Fig. 10.—*Aseroe rubra*. $\times \frac{2}{3}$.—Small 7-armed form after emergence from the volva. (Photograph by the author.)

Plate ix.

Fig. 11.—*Aseroe rubra*. $\times \frac{2}{3}$.—Fully expanded 8-armed form. (Photograph by the author.)

Fig. 12.—*Aseroe rubra*. $\times \frac{2}{3}$.—Section through the unexpanded plant showing the compressed stem, manner in which the arms are folded, massive gleba, thick gelatinous layer of the peridium, and the distinct peridial plates. (Photograph by the author.)

Fig. 13.—*Aseroe rubra*. $\times \frac{2}{3}$.—The form known as *A. Muellerianus*, showing the greatly enlarged apex of the stem and the short arms. Photograph of a water-colour by Miss Phyllis Clarke in the possession of Dr. Cleland, based on a plant collected at Mosman, 5/15.

Fig. 14.—*Linderia columnata*. $\times \frac{2}{3}$.—Photograph of a water colour by E. H. Atkinson based on a specimen collected at Kaituna, Canterbury.

Fig. 15.—*Linderia columnata*. $\times \frac{2}{3}$.—Photograph showing the free bases of the columnar arms of the receptacle. (After Linder, 1928.)

Fig. 16.—*Laternea triscapa*. $\times \frac{2}{3}$.—Photograph showing the specialized glebiferous structure characterizing the genus. (After Linder, 1928.)

Fig. 17.—*Colus hirsutinosus*. $\times \frac{2}{3}$.—Photograph of a water colour by Miss Phyllis Clarke in the possession of Dr. Cleland, based on a plant collected at Milson Island, 3/16.

Fig. 18.—*Clathrus cibarius*. $\times \frac{2}{3}$.—Section through an unexpanded plant showing the strongly convoluted receptacle, the enclosing peridium and marked peridial plates. (Photograph by E. B. Levy.)

Plate x.

Fig. 19.—*Clathrus cibarius*. Natural size. A partially expanded plant showing the strongly convoluted receptacle. (Photograph by E. B. Levy.)

Fig. 20.—*Clathrus cibarius*. $\times \frac{1}{2}$.—A fully expanded plant showing (in this instance) two receptacles arising from the common volva. (Photograph by E. B. Levy.)

Fig. 21.—*Clathrus pusillus*. Natural size.—A form with an exaggerated stem-like base upon which Fischer based *Colus Muelleri*. (After Fischer, 1890.)